

STUDY OF THE MARINE FAUNA OF THE KARWAR COAST AND NEIGHBOURING ISLANDS

BY

A. M. PATIL, M.SC.

(*Department of Biology, Karnatak College, Dharwar*)

PART I: PROTOZOA TO ARTHROPODA

(*With a map*)

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I. INTRODUCTION

Most of the available knowledge of the fauna of the west coast of India is confined to the narrow limits of fishes, as such work was undertaken mainly by the Departments of Fisheries of the several States bordering the coast. The present work was undertaken with a view to study the fauna from an academic standpoint. Karwar being the nearest coastal town from Dharwar and exhibiting various types of ecological conditions, was chosen for study. The marine fauna of the Karwar coast has not been investigated by any zoologist so far. In 1940, however, two naturalists, Dr. Maurice Suter and Mr. Charles McCann, made certain observations which were mainly concerned with the angling of fishes and the inland fauna of the place.

With a view to collect a comprehensive knowledge of the fauna, several trips, arranged during the various seasons of the year, were carried out and these have given an idea of the seasonal fluctuations of the marine life of this coast. The animals were studied with reference to their natural surroundings, and in the present paper, no attempt has been made to study the detailed systematics of the specimens collected. Such a study has, however, been started with some groups, particularly the Mollusca, and the account will be published in due course.

The paper is written with a view to facilitate any biologist who may be interested to collect and study the forms available in this area. Hence, some of the conspicuous features of many of the animals have been included. Wherever possible the ecological conditions have also been alluded to.

I wish to express my indebtedness to Prof. P. W. Gideon, M.A., Head of the Department of Biology, Karnatak College, Dharwar, who introduced me to this interesting study by initiating and joining the collection trips and for helping me in various ways throughout the period of study. I am equally indebted to Dr. J. P. Joshua, M.A., Ph.D., Professor of Zoology, Madras Christian College, Tambaram, for his keen interest in my work and for guiding me in the field work as well as laboratory study. My thanks are also due to my colleague, Shri H. V. Kashyap, M.Sc., for his helpful suggestions in preparing the manuscript. I also wish to thank my colleagues and students who joined me in the collection trips and enriched the collections.

II. METHODS OF COLLECTION

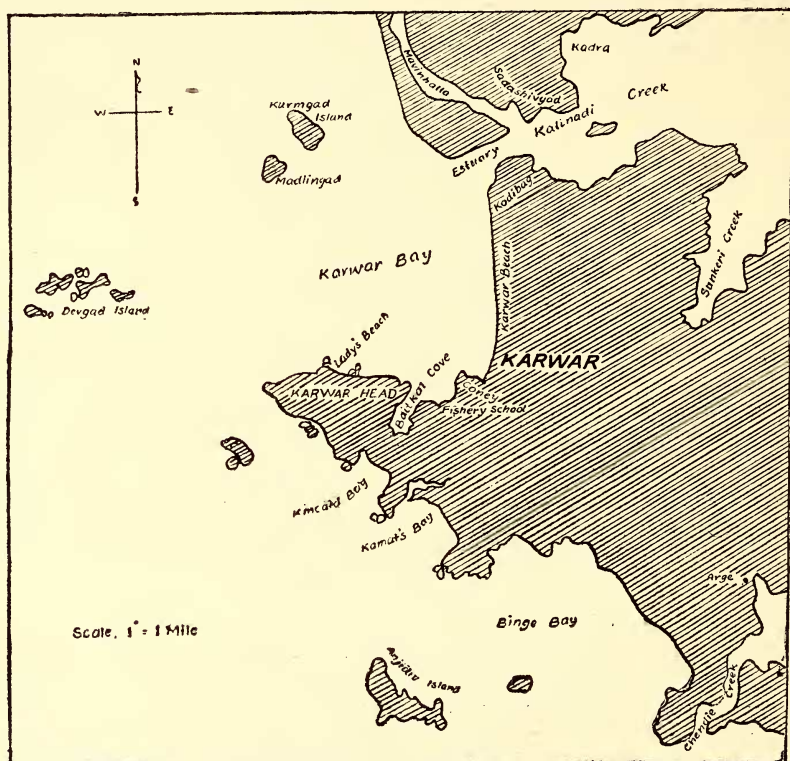
Most of the shore collection was made at low tide. In sandy areas, the specimens were collected by hand or digging with a spade. In rocky areas, the hammer and chisel were used for removing the animals which were firmly attached to the rocks. The nets drawn by the fishermen to the beach were also examined. Plankton collections were made from the open sea by using a fine bolting silk tow-net, dragged along by the local boats fitted with outriggers. Usually the plankton was collected at intervals throughout the night. Specimens were also collected by dredging at certain areas in the Karwar Bay. An iron dredge measuring 2 ft. by 1 ft., with a string net of close mesh reinforced by a coir netting of large mesh, was used for the purpose.

III. CONDITIONS ON THE KARWAR COAST

Karwar, the headquarters of North Kanara District, is about 300 miles south of Bombay (latitude 14° to 15° N; longitude 74° to 75° E). The entire coast is hilly and rocky and at many points steep hills rise straight up from the sea. At the southern end a piece of land juts into the sea and is known as the Karwar Head, the shores of which are all rocky. On the northern side of Karwar Head, however, is a small sandy beach—Lady's Beach—hemmed in between two large projections of rocks. Between the Karwar Head and the mainland is an extension of the Karwar Bay, which is known as the Baitkal Cove. This cove is shallow and has a muddy bottom and nearly half of it is exposed at low tide. On the west and parallel to the town stretches the long sandy Karwar Beach, extending from the mouth of the river Kalinadi in the north to Coney Point in the south. This beach is about three miles in length and is the longest sandy beach near about Karwar.

About three miles north of Karwar town is the village, Kodibag, which is situated on the bank of the Kalinadi estuary. On the opposite bank is the small town, Sadashivgad. To the west of Sadashivgad is a small stream called Mavin Halla, which enters the Kalinadi river just before it joins the sea. At low tide a large extent of this stream is exposed forming a rich collecting ground of estuarine forms. Further up the river, on the northern bank, near

the village Kadra, there is a vast muddy area which is exposed at low tide. On the southern bank, opposite the Kadra area, is a long muddy creek of the river extending for about two miles in a southern direction. This is the Sunheri Creek. The fauna in both



Karwar Coast and neighbouring Islands.

these areas, as also on the small mud-banks situated in the river and exposed at low tides, is very similar.

In Karwar Bay there is a cluster of islets known as Oyster Rocks. On the largest of these, Devgad Island, about seven miles west of the mainland a light-house has been built. About four miles north-east of these rocks are situated two more islets known as Madlingad and Kurmugad. Five miles south-west of Karwar and about two miles from the mainland there is a Portuguese island known as Anjidi.

Along the road to Ankola, the rocky coast is broken up by several sandy beaches which are placed in between groups of rocks that jut into the sea. The first of these sandy beaches is called Kincald's Bay and is about a mile from the town. Further down about two miles and three miles from the town, are Kamat's Bay and Binge Bay respectively. The majority of the animals recorded in this paper have been collected from Kamat's Bay. About five miles from Karwar, on the road to Ankola, is the village Arge.

Between this village and the sea, there is an expansive flat sandy area (about 6 sq. miles), through the middle of which a narrow stream meanders into the sea. This area called the Chendie Creek is completely submerged at high tide.

Thus Karwar presents a variety of ecological conditions showing a representative marine fauna. There are sandy beaches, rocky shores, islands, coves, creeks, an estuary, mud-flats and marshes, all within easy reach of the town.

IV. SYSTEMATICS

PROTOZOA

All the Protozoans recorded were from the plankton collected in Karwar Bay. The majority of the forms are flagellates belonging to the genera: *Noctiluca*, *Ceratium*, *Gymnodinium* and *Peridinium*. *Noctiluca* has been observed in large numbers and they can easily be recognised at night by the bio-luminescence they exhibit whenever the surface water is disturbed. *Ceratium* is represented by three species: *C. tripos*, *C. fusus*, and *C. furca*.

Radiolarians were represented by the genus, *Acanthometra*, which were seen in quite good numbers, especially in the plankton collected at midnight. Sometimes, a few living Foraminifera have also been observed in the plankton. Large numbers of their skeletons, however, are washed ashore and can be seen if a sample of sand is examined under the microscope. The Ciliates are represented only by the Vorticellids attached to bits of sea-weeds.

PORIFERA

No special search for sponges has been made, but a few pieces washed ashore and some encrusting on the rocks have been collected. *Adocia* is the encrusting form found on the rocks of Kamat's Bay and Binge Bay. It may be orange, yellow, green or blue in colour. *Halisarca* is the one that is usually washed ashore and has been collected at Kamat's Bay and Anjidiv island. It consists of small branches with conspicuous oscula.

COELENTERATA

Coelenterates are well represented in Karwar. They include the representatives of all the four classes of the phylum except the corals, which have not been observed in a living condition at all, but a few pieces of dead coral have been collected occasionally on the shore. The most familiar coelenterate, however, is the jelly-fish.

HYDROZOA:

Sertularia is the most common form found beneath the rocks on all the rocky shores. The colonies are dark in colour and may be found under water or sometimes exposed at low tide. A few hydrozoan medusae and some microscopic siphonophores have been

observed in the plankton. *Physalia*, one of the large siphonophores, has often been found washed ashore, and *Porpita* is frequently seen floating about as a disc with dark blue-green marginal tentacles. Two other siphonophores, *Diphyes* and *Monophyes*, have been collected in very large numbers, only once, during May 1946, in Kamat's Bay. The whole beach was glistening with the beautiful floats of these forms.

SCYPHOZOA :

Two common jelly-fishes known in Karwar are *Dactylometra* and *Acromitus*. *Dactylometra* is the larger of the two types, where the umbrella is comparatively flat and the surface coarse to the touch. The lips are produced into long delicate arms. *Acromitus* has a dome-shaped umbrella with a smooth outer surface which appears finely granular when magnified. The lips are divided into eight short thick arms, each produced into a long thread-like filament. In certain seasons, generally during the cold weather, these jelly-fishes appear in shoals and are found washed ashore in enormous numbers.

ANTHOZOA :

Among the Anthozoa, sea-anemones and *Cavernularia* are the only forms best represented in Karwar. Corals are almost absent and none have been recorded in the living condition so far, but dead and worn out pieces of the coral, *Goniastrea*, have been collected sometimes. Fragments of *Gorgonia* have also been collected occasionally on the shore. Sea-anemones have been recorded in a variety of places, on free surface of rocks, in the holes and crevices of rocks, buried in sand, in rock-pools and attached to molluscan shells either empty or occupied by hermit-crabs. The sea-anemones occurring in these habitats are described as follows:

Actinidae: *Anemonia* is fairly common in the intertidal zone, generally on bare surfaces or crevices of rocks. The margin of the discs bears a number of irregularly arranged knobs and numerous tentacles. The animals are usually red in colour, sometimes purple, and the tentacles are darker or even deep violet with light-coloured tips.

Bunodactis has a number of species very variable in its characters, but all have longitudinal lines of warts on the column. The species found in Karwar are about $1\frac{1}{2}$ inches in length and are attached to rocks either submerged in water or exposed only at low tide. The upper part of the column bears longitudinal rows of suckers to which are attached fragments of shells and other particles. The disc is greenish in colour and the tentacles are pale and pointed.

Sagartidae: *Sagartia* is a very common form attached to molluscan shells, empty or occupied by hermit-crabs. Many have been collected attached to empty shells of *Turritella* (*T. acutangula*) buried in the sand with only the disc exposed. When contracted, *Sagartia* looks like a small translucent onion with a few filaments projecting from the pointed end. These anemones are brownish

yellow in colour with light longitudinal stripes. When fully expanded the column is about two inches in length.

Zoanthidae: *Zoanthus* is a small colonial form frequently seen in the crevices of rocks or in the rock-pools in the tidal region. Its column is long and yellowish grey in colour and the disc presents shades of brown with a variety of green marks. The tentacles are striped and are of different colours. When sand particles are strewn over the disc by the action of waves, the animal is difficult to detect.

Gemmaria is similar to *Zoanthus*, but is smaller and generally found in large numbers spreading over the rocks. When expanded, they form a conspicuous mosaic of hexagonal figures. They usually grow on horizontal and vertical surfaces of rocks. These animals are sand-encrusted and leathery to the touch. The column and the tentacles are brown and the disc is green.

Cavernularidae: *Cavernularia* is a pear-shaped colonial form and a very beautiful object to see when expanded. They stand erect in water with only the stalks buried in the sand. They have been observed in large numbers in their natural surroundings, in the creek at the mouth of the river Kalinadi. Occasionally, however, they are washed on the beach in a contracted condition, when they look like short clubs with narrow grooved handles and with brown depressions over the rest of the body, indicating the position of the contracted polyps.

CTENOPHORA:

Two representatives of Ctenophora, observed in Karwar, are *Pleurobrachia* and *Beroe*. *Pleurobrachia* has been collected in large numbers, washed ashore on the beaches and looking like small blobs of jelly. *Beroe* has also been collected occasionally on the shore and sometimes in the plankton.

PLATYHELMINTHES

The common marine flat-worms are the planarians, found crawling on the rocks, sea-weeds and among the bivalve molluscs. Some have colours merging with the background, sometimes brown and grey, and are often inconspicuous, while others are brilliantly coloured. The planarians of Karwar have not been identified.

NEMERTEA

The Nemertine worms, collected from Kamat's Bay, were found on the rocks among the attached animals and sea-weeds. Only two forms are known. *Eupolia* is a slender brownish red worm with a dark streak on the middle of the back. It was about ten inches in length when expanded. Another worm about twenty inches long was collected from the same locality. It was violet in colour with regular, narrow, circular white bands at intervals. It resembled *Tubulanus* (*Carinella*, McIntosh), recorded in the British Isles,

ANNELIDA

The free-living Polychaets are represented by a number of Nereid worms collected from sea-weeds, among encrusting animals on rocks, and various other habitats. *Polynoe* is commonly found on the underside of the rocks on all rocky shores. Post-larval Polychaets have also been collected from the plankton. The tubicolous Polychaets are represented by the following four forms :

Polycirrus and *Terebella* are recognised by their numerous long, orange-red, brightly coloured, sticky tentacles. They have been collected from the empty oyster shells encrusted on the loose rocks in the muddy areas of Kadra and Chendie Creek.

Owenia is found in large numbers in Kamat's Bay. They live in sandy tubes which are so closely packed together, that they give the appearance of coral-like encrustations, extending over a large area in the inter-tidal zone. The mouth of the worm is surrounded by a membrane which has marginal filaments.

Spirorbis lives in small calcareous tubes found as encrustations on the sea-weeds. They occur in large numbers all over the coast.

Sternaspis is a representative of the burrowing Polychaets and has been collected by dredging in Karwar Bay. It possesses a short body with a thickened anterior region, carrying on each side three rows of setae. On the ventral side of the posterior end of the body, there is a bilobed horny plate with a number of bundles of long setae. The anus is situated on the dorsal side with two bundles of filamentous branchiae on either side of it.

Dendrostoma is the only Sipunculid represented and is found burrowing into the sponges encrusting the rocks. It is shaped like a base-ball bat, the handle being the neck which is protrusible through a circlet of branching tentacles. Usually it is about four inches in length.

ARTHROPODA

CRUSTACEA :

The Crustaceans, which form the bulk of the marine Arthropods, are found almost everywhere in Karwar. It is difficult to avoid seeing or coming across a crab in any locality of Karwar. Large numbers of Dhobi-crabs waving their coloured chelae can be seen in a number of places. Hermit-crabs inside empty molluscan shells are found everywhere near the shore. The plankton teems with a large variety of minute crustaceans and their larvae. The following are some of the common crustaceans recorded :

COPEPODA : A large number of Copepods are found in the surface waters and have been collected in the plankton. *Calanus* is the most common and is cosmopolitan in distribution. It is recognised by its iridescent plumed hairs borne on different parts of the body, the long antennae and the single egg-sac. There are also many forms of copepods parasitic on the body of fishes.

CIRRIPIEDIA: Acorn-barnacles are by far the commonest. They are found in vast numbers attached to rocks, to wood and to molluscan shells. The following two species are met with in large numbers:

Balanus tintinabulum (Linnaeus) is a large barnacle with purple coloured plates and is found on rocks which are always very near the water.

Balanus amphitrite (Darwin) is a small and lighter coloured animal, found in thousands encrusting the rocks in or near the water. They are found so crowded together that they almost look like sheets covering the rocks.

A point to be noted regarding the feeding habits of these barnacles is that they are dependent on the place of their attachment. Thus, those that are permanently submerged can feed at all times; those living between tide marks obtain their food only twice a day during high tides; and lastly those that live beyond the high tide level get only what little food is provided by the spray that comes their way.

Goose-barnacles are not very common in Karwar. Only two forms have been collected.

Lepas, attached to floating pieces of wood and cuttle-bones, has been occasionally found washed ashore.

Ibla quadrivalvis (?) is found in small groups attached to stones in Kamat's Bay. It is easily distinguished in having only two terga and two scuta, and the animal is completely covered by soft brown spines pointed posteriorly. This species is interesting in that, though its presence in the Indian Ocean has been recorded, the exact locality where it occurs seems not to have been known so far.

Sacculina is the parasitic cirripedia observed on the crab (*Neptunus*), which have been collected from the rampan nets.

ISOPODA: As elsewhere, the Isopods are quite abundant in practically all littoral regions of Karwar. The majority of them are small and many are coloured like their surroundings. Those found among the sea-weeds have almost the same colour as the sea-weeds, red, green or brown. Those living among the rocks are slate-coloured, e.g. *Ligia*. *Ligia exotica* (Roux) is found in large numbers on boats, on logs of wood near water, and along the rocks and stones of the shore. They are semi-terrestrial, living near the water, and would be drowned if submerged for sometime.

Cymothoa has been observed living parasitically in the mouth of Pomfrets (*Stromateus*). It is possible that more isopod parasites would come to light if further search is made, in view of the fact that Karwar has such a rich variety of fishes.

AMPHIPODA: Amphipods are also quite abundant in the littoral regions. *Stenothoe* is a very common sand-hopper, living on sand or on decaying sea-weeds, easily recognised by its jumping movements. Another odd-looking amphipod, seen crawling over the hydroids or algae, is a Caprellid. They move about like a caterpillar with looping movements and their colouration is similar to that of the surroundings.

STOMATOPODA: *Squilla* is the only Stomatopod collected at Karwar. They are seldom found with the objects washed up on the

shore, but are brought in by fishermen in their nets and are discarded as they are inedible. They need to be handled with care because they can inflict injuries with their tails and maxillepedes. *Alima*, the larva of *Squilla*, has often been observed in the plankton. It is recognised by its great size (about 3 cms. in length), glass-like transparent body, long, broad carapace, unlike that of the adult, and a pair of prominent stalked eyes.

DECAPODA: The first large living animals that one frequently meets on the shores of Karwar, are the Decapods, be it a prawn, swimming in the shore waters, or a crab, running about on the beach, or a hermit-crab, strutting about with a molluscan shell.

MACRURA:

Penaeus is the common edible prawn that is sold in the market, either in fresh condition or dried. They can be recognised by their serrated rostrum and chelate legs. They are usually brought to the shore by the fishermen in their nets.

Lucifer, with its elongated body, slender limbs and long eye-stalks, is a luminiscent form usually found in the plankton.

Alpheus is found in the crevices of rocks. Its first thoracic leg, either the right or the left (never both), is very much enlarged. They make a peculiar noise by means of these appendages.

Hippolysmata, possessing a large rostrum and prominent eyes, is usually found in rock-pools and on sea-weeds.

Panulirus is the 'painted spiny lobster' living on the rocks, whose skeleton is often washed ashore.

ANOMURA:

Hermit-crabs, living in empty molluscan shells, are found in large numbers on the shores and also in the rock-pools. A majority of the Karwar forms belong to two genera: *Diogenes* and *Pagurus*, which are recognised by their unequal chelae. Those living in water often carry sessile animals like *Sertularia*, *Sagartia*, or *Balanus amphitrite*, on their backs.

Porcellana is usually found living under encrusting sponges, ascidians and hydroids. Their abdomen is symmetrical and flexed beneath the thorax and bears a well-developed telson. In the plankton, the peculiar Zoea larva of *Porcellana* is observed quite frequently and is readily recognised by the enormously long rostrum and posterior spines.

Emerita asiatica (Milne-Edwards), the mole-crab has an oval body about one inch in diameter and is pinkish in colour. They are very abundant occurring on open sandy beaches between tide marks. As the waves beat shoreward, they emerge from the sand and are carried higher up the shore along with the water, thus exposed to view for a brief period, and when the waves recede they rapidly burrow into the sand and wait for the next wave to repeat the process. During low tide, when they are stranded on the shore, they burrow deep into the sand and reappear at the next high tide.

Albunea symnista (Linnaeus) is another mole-crab, stouter than *Emerita*, and lives buried in the sand below the low tide level, but is sometimes brought to the shore entangled in fishermen's nets. Very few of them have been collected.

BRACHYURA:

Crabs form a characteristic group of the fauna of Karwar. They are found in very large numbers, in a variety of habitats all along the coast. Only those actually found on the shore, or those living in areas adjoining the shore, have been described here. Other crabs living beyond the littoral zone are known only by their remains that are washed ashore from time to time. Crabs belonging to the following six families have been recorded.

Calappidae:

Calappa lophos (Herbst) and *Matuta victor* (Fabricius) are represented here, and of these the former is rare and the latter more numerous.

Calappa lophos has a large arched, semicircular box-like carapace and the crested chelae are massive and fringed with hairs.

Matuta victor has a rounded carapace with a single stout triangular spine projecting on each side. The two chelate arms are large and the four pairs of legs are broad and flat and are used as paddles when swimming. It is much more active than *Calappa*, but usually spends much of its time buried in sand between the tide marks.

Leucosiidae:

Philyra scabriuscula (Fabricius) is the most common species and is found in large numbers on the sandy beaches between tide marks in Kamat's and Binge Bays. They are small lightly coloured crabs, more or less globular in shape, with long slender legs. They are usually seen hurriedly burying themselves into sand as the waves retreat.

Portunidae:

These are swimming crabs with only the last pair of legs paddle-like, the first three pairs being adapted for walking. The carapace is depressed with distinct characteristic teeth on the antero-lateral margins. The following three are the most common genera: *Neptunus*, *Charybdis* and *Thalamita*. These are the common edible crabs sold in the market and are collected from fishermen's nets.

Neptunus is recognised by the antero-lateral margin of the carapace bearing nine teeth and a long spine projecting sideways. Two species have been collected: *Neptunus pelagicus* (Linnaeus) and *N. sanguinolentus* (Herbst). In the former, the carapace has a network of coloured markings and the back margin of each of the chelae bears a terminal spine. It is commonly seen swimming rapidly in the shallow waters of the creeks, with one chela stretched and trailing behind, and then often mistaken for a fish. In *N. sanguinolentus*, the carapace is uniformly coloured with three

large red spots on it, and the back margin of the chelae is without teeth.

Charybdis has the antero-lateral margin of the carapace with six teeth and is collected in good numbers from the nets. In one species, *C. crucnera*, the design on the carapace looks like two angels on either side of a distinct cross and it is therefore held in reverence by some Christians.

Thalamita has five teeth along the antero-lateral border and the eyes are widely separated. It is usually found in the creeks.

Xanthidae:

Xantho and *Atergatis* are the two forms found on rocky shores between tide marks. The antero-lateral borders of the carapace are thick and blunt. *Xantho* is small with heavy chelae and the surface of its carapace is furrowed. *Atergatis* is bigger and oval in shape, with the surface of the carapace smooth and pink coloured with small white spots all over.

Grapsidae:

Grapsus strigosus (Herbst) is the common form found in large numbers on the rocky shores, seen either in or out of water. They are very active crabs with a medium sized, roughly hexagonal, flattened carapace, which is green in colour and shows dark stripes directed towards the posterior median line.

Ocypodidae:

The members of this family are very prolific on the shores and the creeks. The carapace is more or less convex, eye-stalks greatly developed, and the legs have pointed ends. They are active creatures living in deep burrows on the sandy shores. This family is represented by the following three genera: *Ocypoda*, *Dotilla* and *Gelasimus*.

Ocypoda is a familiar genus living in burrows in the sand near or above the high tide mark. They are flesh coloured, with the eye-stalks extending beyond the corneal surface. They run fast on the tips of their legs, keeping the body well raised above the ground. When chased they retreat into their burrows or escape into the sea. They can be seen in large numbers at night.

Dotilla are found moving about in groups of thousands in the Chendie Creek. They are small in size with globose bodies, living in sand or mud only below the high tide level, usually in the backwaters, but never on steep beaches. Their appendages are slender and pink coloured, and the body is dark.

Gelasimus or the 'dhobi-crab' is more common than *Dotilla* and is found in very large numbers on sand or mud banks of Chendie Creek and Kalindi estuary, usually along with *Dotilla*. The males are characterised by having one chela very large and brilliantly coloured, and they have a peculiar habit of constantly waving this chela (like a dhobi beating clothes on a stone, hence the name), sitting at the mouth of its hole, presumably to attract the mate. Extensive areas of mud banks with thousands of waving chelae of these crabs is a very impressive sight in Karwar.

ARACHNIDA:

The only marine arachnid observed is a pycnogonid occurring in Kamat's Bay. These 'no-body-crabs' are generally found crawling among the hydroids, sea-weeds and polyzoans.

INSECTA:

Strangely enough there is only one true marine insect, which is found in the sea far from the shore. It is the wingless bug, *Halobates*, whose eggs in various stages of development are often found on the cuttle-bones washed ashore.

Cicendela is a beetle, that is found on the shore among decaying weeds, and is recognised by the way it takes to wing when a wave rushes up, and settles on the sand as soon as the water recedes. *Dermestes vulpinus* is another beetle found in large numbers infesting the fish that is being cured.

A species of *Musca* is found in thousands in the fish-curing yards during the mackerel season. There is also a species of *Tabanus*, a few specimens of which have been collected in Kamat's Bay.

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